

The Influence of Coastal Saltmarsh Vegetation On LiDAR Elevation Measurement Accuracy

Abstract

The recent availability of airborne LiDAR data covering the most populated areas of Tasmania's coastal zone has stimulated considerable interest in its potential for a range of applications including land use planning, ecosystem research, coastal development policy and building codes, emergency response planning, and communications, particularly given the heightened awareness of impending climate change and sea level rise impacts on the coastal zone. Acquired for the Climate Futures for Tasmania project, the data provides high accuracy, high resolution elevation measurement not previously available in broad-scale terrestrial elevation data. A stated vertical accuracy of ± 25 cm makes the data better suited to detailed assessments and decision making than alternative large area digital terrain datasets.

However, the levels of accuracy stated in LiDAR data specifications usually apply to best-case vertical accuracy assessments for open, level terrain. Interference from above-ground features such as vegetation is known to reduce the reliability of LiDAR elevation measurements. In particular, low-lying, dense vegetation cover poses significant challenges for automated and semi-automated vegetation filters and elevation correction algorithms. Existing approaches to the separation of ground from above-ground LiDAR returns have not been universally successful due to the constraints of sensor system hardware capabilities, ineffective data filtering techniques, and the inability of laser pulses to fully penetrate closed canopy vegetation. The Climate Futures for Tasmania data provides evidence of the misclassification of laser returns due to sensor system and data processing limitations.

The broad aims of this study were to apply ground truthing to quantify the influence of low saltmarsh vegetation on the quality of Climate Futures for Tasmania data, to investigate a method for separating ground and low vegetation returns to improve ground elevation estimation, and to construct digital elevation, canopy surface and

canopy height models using separated ground and vegetation returns.

Results from the study concluded that the classified point data and digital elevation model provided to the Climate Futures for Tasmania project contained statistically significant elevation errors for the areas tested. For vegetated terrain, strong linear relationships between surveyed and LiDAR elevations were not evident. The approach adopted to separate ground and vegetation returns was not effective in significantly improving the accuracy of digital elevation modelling over the saltmarsh platform. While vegetation-related elevation error was significant for each vegetation group assessed, no significant difference was detected between groups. The variability of vegetation height and structure within the marsh, combined with uncertainty in the geolocation of the LiDAR footprint, were identified as primary impediments to a more reliable assessment of vegetation influences on LiDAR accuracy. Upward bias in LiDAR ground elevation coupled with a reduction in vegetation height measurement due to laser infiltration of the upper canopy resulted in a significant underestimation of vegetation height.